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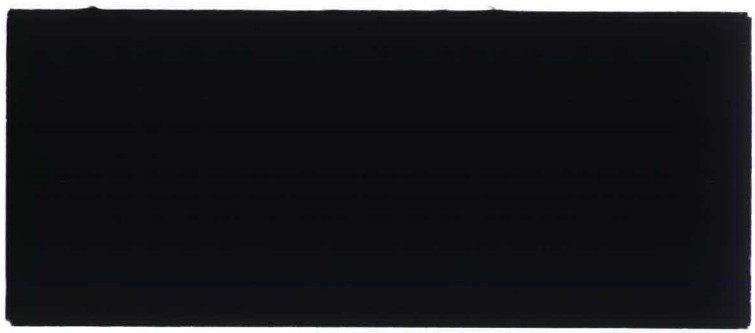
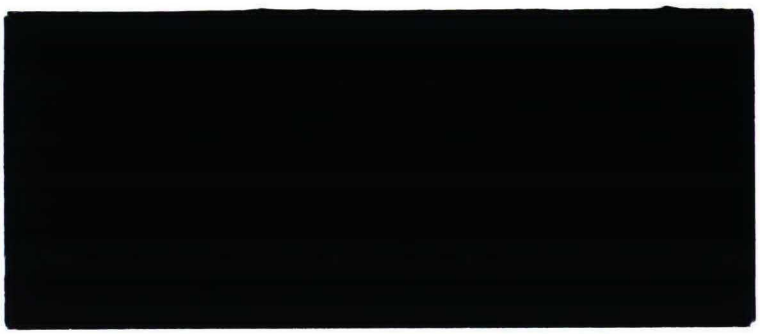
Publication date:
1987



DEPARTMENT OF ECONOMICS

RESEARCH MEMORANDUM



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The determinants of the currencies within the European Monetary System *

January 1987

FEW 241

* Also presented as a paper for the SUERF-Colloquium 'International Monetary and Financial Integration - The European Dimension', held in Luxembourg at October 9-11, 1986.

1. The exchange rate mechanism of the European Monetary System[1)]

July 1978 the European Council of the heads of state and government agreed in Bremen to the establishment of the European Monetary System (EMS). The main features of the system were set out at the Brussels meeting of the Council in December 1978[2)].

The EMS went into operation as of March 13, 1979, after certain questions relating to the common agricultural policy had been resolved. At the same time, the 'snake-arrangement' for the exchange rates of some member states of the European Community - Belgium, Denmark, France (until March 1976), Luxembourg, the Netherlands and West-Germany - ceased to exist. All former member countries of the European Community, except the United Kingdom, decided to participate in the EMS, including the exchange rate mechanism. The United Kingdom did not take part in the operational heart of the EMS, the exchange rate mechanism. More recent members of the European Community - Greece (from 1981), Spain and Portugal (from 1986) - also did not join the EMS. Nevertheless, the pound sterling and the Greek drachma are included in the basket that forms the European Currency Unit (ECU), which serves as a numéraire for the exchange rate mechanism, as a denominator for the intervention mechanism and as a reference point for the divergence indicator. The exchange rate and intervention mechanism of the EMS is made up of two separate but overlapping components, i.e. the 'parity grid' and the 'divergence indicator'. The parity grid is a matrix of bilateral central rates, around which fluctuation margins have been established, and is broadly similar to the previous snake-arrangement. The divergence indicator shows the movement of the exchange rate of each currency against the weighted average movement of the other currencies and aims to identify at an early stage when one participating currency is beginning to diverge from the other currencies within the EMS.

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1) The author wishes to acknowledge Professor Hans Visser for helpful comments and Mr. Jan Willem in 't Veld for his valuable research assistance.

2) The objective of the EMS has been stated as a 'zone of monetary stability in Europe'. See European Economy, no. 3 (July 1979), p. 94.

1.1. The parity grid and the relative positions of the currencies

All participating currencies[1] have a central rate or parity expressed in terms of the ECU. By dividing these central rates vis-à-vis the ECU through each other the bilateral central rates or cross-parities are determined. Thereby a parity grid is generated with intervention limits 2,25% above and below the bilateral central rates and thus a maximum fluctuation range of 4,5% around these rates was allowed. Only Italy as a former non-snake-country opted for a (temporarily) wider fluctuation margin of plus or minus 6% instead of the regular 2,25%. Each central bank is obliged to intervene in order to keep the market rate for its own currency within the bilateral intervention limits. When a bilateral intervention limit is approached, the central banks of the countries concerned must intervene in the exchange market to unlimited amounts. The central bank with a strong currency will buy the weak currency, while the central bank with a weak currency will sell the strong currency. However intervention in other currencies - mainly U.S. dollars - is allowed and has been undertaken. The commitment to intervene may put a heavy burden on the countries with weaker currencies, because the possibly extensive and prolonged intervention will diminish their stock of official reserves. To prevent too much pressure on the mechanism, timely and smooth adjustments of the central rates - called 'realignments' - were permitted subject to mutual agreement by a common procedure, which involved all participating countries. Such realignments had to guard the EMS against becoming a rigid system like the snake-arrangement, which the weaker countries would leave as soon as they could no longer meet the obligation to intervene. Up to August 1986 nine realignments have taken place during the EMS. Therefore the system is one of fixed but adjustable exchange rates between the seven currencies.

The parity grid of bilateral central rates and intervention limits is the core of the exchange rate mechanism of the EMS. The bilateral market rates within this grid can be alternatively represented by the 'relative positions' of the currencies within the EMS-band of fluctuation. The relative

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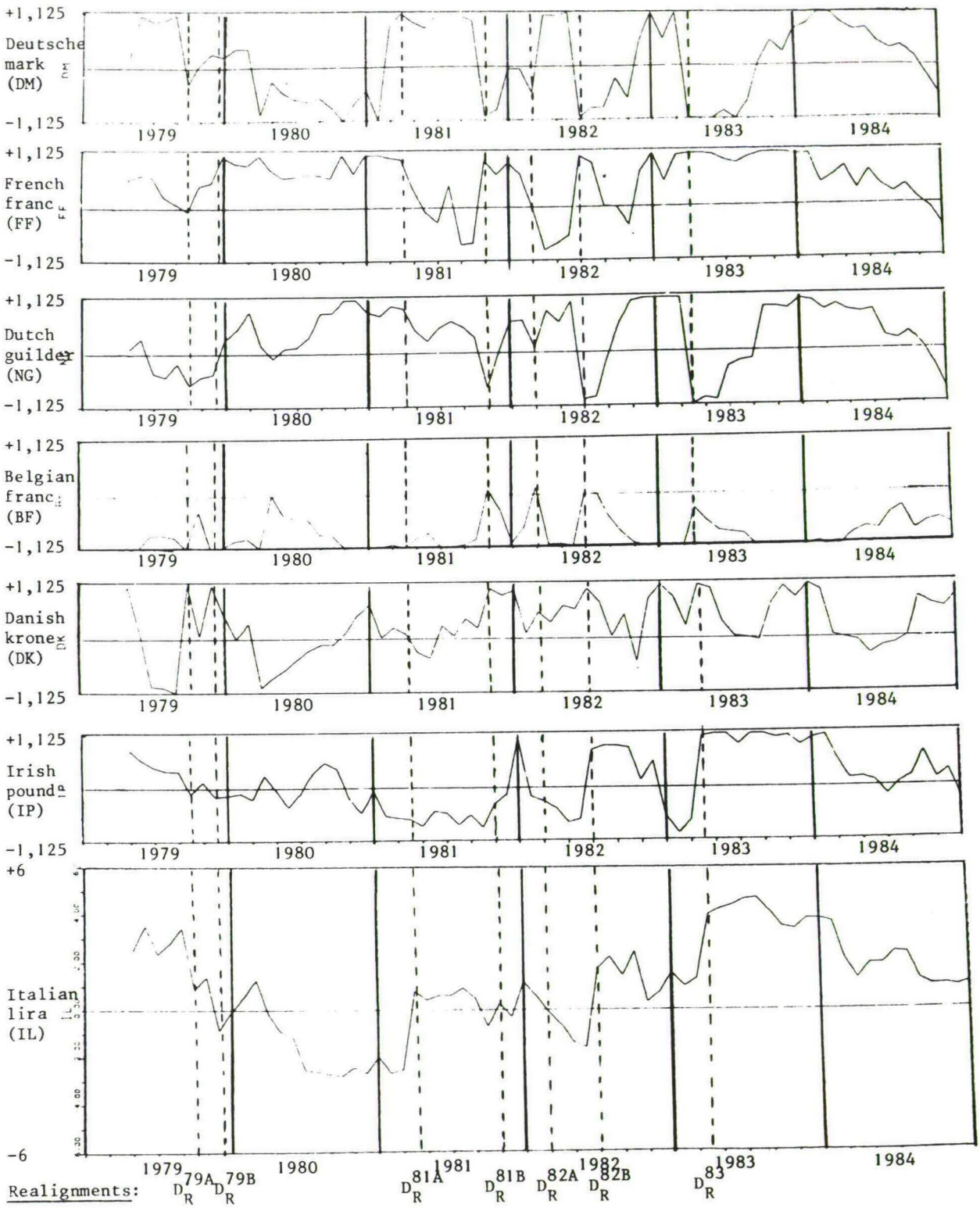
1) Herewith is referred to the currencies of the countries which participate in the exchange rate mechanism of the EMS, i.e. the Belgian-Luxembourg franc, Danish krone, Deutsche mark, Dutch guilder, French franc, Irish pound and Italian lira.

Figure 1. The relative positions of the EMS-currencies (last friday of the month).



Source: De Nederlandsche Bank (Dutch central bank).

positions of the various EMS-currencies are shown in figure 1 for the period from April 1979 up to December 1984.

When the relative position of a currency reaches the upper or lower limit of the EMS-band of fluctuation, the central bank of the country concerned must intervene in the exchange market. Thus this band is to be conceived as a target zone for the external value of each currency[1]. The relative position indicates the position of a currency in relation to two other currencies within the EMS, namely the strongest currency and the weakest currency. These are the currencies which are the closest to the respective upper and lower intervention limit of the EMS-band of fluctuation.

If H_t and H^* are the bilateral market and central rate of the strongest currency vis-à-vis any other currency Z, then the appreciation of the strongest currency against its central rate is in period t:

$$(1) \qquad \dot{H}_t = \frac{H_t - H^*}{H^*} \quad .$$

The 'reference-currency' Z may be any currency within the EMS, except the Italian lira. Furthermore, if L_t and L^* are the bilateral market and central rate of the weakest currency vis-à-vis the same currency Z, then the depreciation of the weakest currency against its central rate is in period t:

$$(2) \qquad \dot{L}_t = \frac{L_t - L^*}{L^*} \quad .$$

The average of the appreciation of the strongest currency and the depreciation of the weakest currency $[1/2(\dot{H}_t + \dot{L}_t)]$ determines the 'central position' within the EMS-band of fluctuation, which is shown in figure 1 as the zero-line. Similarly, if X_t and X^* are the bilateral market and central rate of a certain currency X vis-à-vis currency Z [2], then the appreciation or depreciation of that currency X against its central rate is in period t:

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1) Since the currencies in the EMS are floating as a block against third currencies, there is no absolute measure against which the relative appreciation or depreciation of each currency can be calculated. See Bank of England, Intervention arrangements in the European Monetary System, Quarterly Bulletin, vol. 19, June 1979, p. 191.

2) The reference-currency Z may also be the currencies H, L or X, although small differences in approximation could occur. To avoid these, the weakest currency L can be chosen as reference-currency (Z = L). Cf. Central Bank of Ireland, A Guide to the Arithmetic of the EMS Exchange-Rate Mechanism, Quarterly Bulletin, autumn 1979, p. 96.

$$(3) \qquad \dot{X}_t = \frac{X_t - X^*}{X^*} \quad .$$

Finally, the 'relative position' of currency X within the EMS-band of fluctuation can be defined as the appreciation or depreciation of currency X vis-à-vis the central position (zero-line) and is therefore in period t:

$$(4) \qquad EMS_t^X = \dot{X}_t - 1/2(\dot{H}_t + \dot{L}_t)$$

Thus a relative position expresses at any moment the position of a currency with regard to both extreme EMS-currencies and reflects in this way the strength of a currency. It is important to realize that these two extremes (H and L) are not always the same currencies, but can alternate from time to time.

Because the intervention limits within the parity grid lie 2,25% above and below the central rates or parities, the maximum deviation between the strongest and weakest currency within the EMS-band must be 2,25% as well. In case the strongest currency is e.g. 2,25% above par vis-à-vis another currency, it implies that the last currency have to be the weakest in the system. No other currency - the Italian lira left aside - can fall below this currency for its bilateral intervention limit against the strongest currency would then be exceeded. Therefore, the maximum and minimum relative positions of each currency (except the Italian lira) are +1,125 and -1,125 respectively and these correspond with one or more upper and lower intervention limits within the parity grid.

When the strongest currency reaches a relative position of +1,125 and the weakest currency of -1,125, the central banks concerned must intervene in the exchange market[1].

Until now the Italian lira was left out of consideration. The relative position of the lira within the EMS-band of fluctuation is defined in the same way as the appreciation or depreciation of the lira vis-à-vis the central position in period t:

$$(5) \qquad EMS_t^{IL} = \dot{IL}_t - 1/2(\dot{H}_t + \dot{L}_t) \quad ,$$

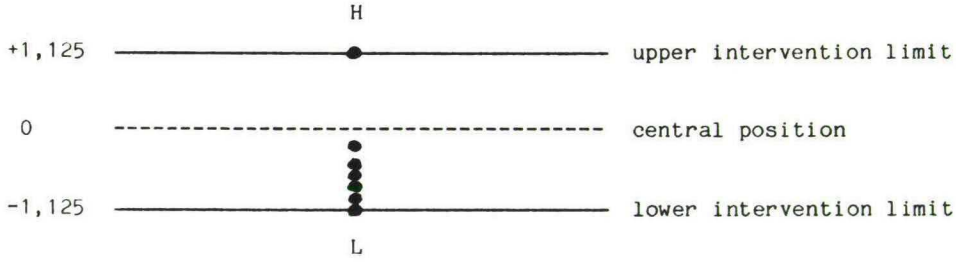
1) The relative positions of the strongest and weakest currency lie naturally symmetrical with regard to the central position (zero-line) within the EMS-band.

where $\dot{IL}_t$ is the appreciation or depreciation of the lira against its central rate vis-à-vis currency Z. On account of the wider intervention limits for the Italian lira within the parity grid (± 6%), the central position is determined by the strongest and weakest of the other EMS-currencies. Consequently, when the relative position of the lira lies between ± 4,875 and ± 6%, the central bank of Italy can be forced to intervene. Thus in interpreting the relative positions of the other EMS-currencies, the relative position of the lira should be considered also.

1.2. The divergence indicator

The second component of the exchange rate mechanism of the EMS is the 'divergence indicator', which can be regarded as a supplement to the parity grid[1]. In particular the former non-snake countries - France, Ireland and Italy - favoured a system in which the currency with the greatest deviation from the weighted average of the EMS-currencies should carry the burden of adjustment. Within the parity grid with bilateral fluctuation margins it might happen that, if an important currency like the Deutsche mark e.g. strongly appreciates vis-à-vis the other currencies, one of those currencies would be the first to reach the intervention limit against that strong currency.
Such a situation within the EMS-band is shown in figure 2.

Figure 2. An asymmetrical situation within the EMS-band



1) For an extensive discussion of the 'divergence indicator' see e.g. J. Salop, The Divergence Indicator: A Technical Note, IMF Staff Papers, vol. 28, 1981, pp. 682-697.

Therefore, the countries with weak currencies wanted a system which indicates the relative deviations of the currencies from the weighted average movement within the EMS, as reflected by the appreciation or depreciation of the ECU against its central rate. The country of the currency with the greatest deviation vis-à-vis the ECU should take appropriate measures to reduce this deviation.

As seen above, the maximum allowed deviation from the bilateral central rates is 2,25%. If the weight of a currency X within the ECU-basket is called W_X, then the 'maximum divergence spread' S_X is:

$$(6) \qquad S_X = \pm 2{,}25\ (1-W_X) \quad .$$

This is the maximum possible deviation between the ECU-market rate and the ECU-central rate of that currency X and will be achieved when the currency is at its intervention limit.

Furthermore, for currency X a 'threshold of divergence' T_X is set at 75% of its maximum divergence spread S_X:

$$(7) \qquad T_X = \pm 0{,}75\ [2{,}25(1-W_X)] \quad .$$

Thus the threshold of divergence takes account of the weight of each currency in order to eliminate its influence on the probability of reaching a threshold in case of an unilateral movement of that currency. Moreover, the 'divergence indicator' I_t^X for currency X in period t is defined as the relative deviation between the ECU-market rate of that currency (ECU_t) and its ECU-central rate (ECU^*), expressed as a proportion of the maximum divergence spread[1]:

$$(8) \qquad I_t^X = \frac{\dfrac{ECU_t - ECU^*}{ECU^*} \cdot 100}{2{,}25\ (1-W_X)} \quad .$$

1) The divergence indicator can be pulled out of true by the Italian lira and the pound sterling, which are included in the ECU-basket, but to which apply wider (± 6%) or no bilateral fluctuation margins. To neutralize these distortions, the divergence indicator is adjusted by eliminating the movements of the lira and the pound sterling beyond the fluctuation margin of ± 2,25%. This adjustment is approximate and therefore questionable.
See Nationale Bank van België, Het Europees monetair stelsel, Tijdschrift van de Nationale Bank van België, vol. 54, July-August 1979, pp. 39-41.

So the divergence indicator will be zero, when the ECU-market rate equals the ECU-central rate, in other words if the movement of this currency against its central rate exactly corresponds with the weighted average movement of the EMS-currencies. In case the divergence indicator exceeds +75% or falls below -75%, the threshold of divergence is crossed and the concerning country will be presumed to take adequate measures, such as diversified intervention, realignment of central rates, or measures of domestic monetary and economic policy. Nevertheless, no country can be compelled to take these measures within the system of the divergence indicator.
Hence, the divergence indicator is relegated to a minor role within the EMS. It acts as an early warning system without any commitments. In addition the divergence indicator has some practical drawbacks. Firstly, the use of the indicator does not lead necessarily towards monetary stabilization, but rather induces a tendency towards the average monetary development within the EMS. Secondly, the indicator works only as a warning system if one currency clearly diverges from the other currencies. However it fails when two currencies strongly move in opposite directions and the other currencies are in the middle, because then no divergence threshold could be crossed. Finally, the indicator would operate better as a signal by lowering the divergence threshold e.g. from 75 to 50% of the divergence spread, but this would also imply a very frequent crossing of the threshold making the indicator worthless[1]. In future the subordinated system of the divergence indicator will therefore be left aside because of its small importance.

1.3. The determinants of the relative position of the currencies

The exchange rate mechanism of the EMS consists of a grid of bilateral fluctuation margins supplemented by a warning system of weighted divergence thresholds vis-à-vis the ECU. This was a political compromise between the former snake-countries, which favoured a continuation of the snake-arrangement, and the non-snake-countries, which advocated a different mechanism.
That compromise can be characterized as a system of managed floating market rates (relative positions) around a fixed but adjustable central rate (central position). Within the established intervention limits the market

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1) For a description of these drawbacks see H. Ungerer, The European Monetary System: The Experience, 1979-82, Occasional Paper no. 19, International Monetary Fund, Washington D.C., May 1983, pp. 15-16.

rates (relative positions) are able to move freely depending on the demand and supply of these currencies.

Henceforth, we shall focus on the EMS-band of fluctuation and in particular on the determinants of the relative positions of the EMS-currencies. The relative position does not reflect a term of exchange between two currencies, but a multilateral position of one currency against the others[1]. Thus the determinants of the relative position of a certain currency refer in principle to all EMS-countries instead of only two countries, as in the case of bilateral exchange rates. Therefore, the explanation of a relative position is more complicated and less straightforward than that of a bilateral rate. Moreover, the fluctuations of relative positions will be more difficult to test empirically than those of bilateral rates, because they are more limited.

What are the determinants or explanatory variables of the relative positions of the EMS-currencies? First of all, the relative positions are determined by exchange market interventions or changes in the official reserves of the central banks. A high relative position can the central bank concerned force to intervene by selling its own strong currency in exchange for a weak currency or dollars.

Then the relative position will fall. Consequently, changes in the official reserves of the central bank have a negative influence on the relative position of its currency[2]. Further, the relative positions are affected by balance of payments disequilibria of the countries. A surplus on the current account or the capital account of the balance of payments of a country will increase the relative position of its currency. Thus the accounts of the balance of payments have a positive effect on the relative position of a country's currency. However, capital flows between countries are primarily caused by differences in the rate of return on various liquid assets between these countries. Therefore, the most important determinant of the relative positions is the difference in the interest rate between the EMS-countries, particularly in the money market interest rate. Given

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1) Strictly speaking it is a relation between three currencies, namely of one currency (X) vis-à-vis the strongest currency (H) and the weakest currency (L) within the EMS-band, which can alternate from time to time. For this reason a determinant of the relative position will often be approximated by the difference of a domestic variable and its weighted average counterpart for the EMS-countries.

2) Notice that an appreciation (depreciation) of a currency corresponds with a rise (fall) of the relative position of the currency and a fall (rise) of the exchange rate of a foreign currency expressed in that currency on definitional grounds.

the domestic interest rate in a country, a rise of the interest rate(s) in the other EMS-countries will induce capital export and will result in a fall of the relative position. In this context the Fisherian distinction between nominal and real interest rates may be essential. If the nominal interest rate in the other EMS-countries rises because of an acceleration of the expected inflation, then the relative position will not decrease but increase. For this reason it is decisive for the direction of the influence of nominal interest rate differences, whether these differences are caused by real interest rate differences, or by divergent inflationary expectations within the EMS. Apart from the expected inflation rate the actual inflation rate is also important, mainly in the longer term. A higher actual inflation rate in a country compared with the other EMS-countries will in the long run result in a fall of the relative position of its currency. Nevertheless, the inflation rate differences within the EMS affect above all the central rates and positions of the currencies and are consequently reflected in the realignments of these currencies. In many cases, then the central rates of the countries with high inflation are devaluated and those of the countries with low inflation revaluated. So the short-term development of the relative positions is principally freed from this influence.

2. An empirical study of the relative positions of the currencies: April 1979 - December 1984.

Now the actual development of the relative positions of the EMS-currencies will be empirically analyzed and explained by the above mentioned determinants for the period from April 1979 up to December 1984. First the realignments of the central rates within the EMS need further examination. During the sample period the bilateral central rates have been seven times adjusted by one or more countries and after this period another two times. All realignments up to August 1986 are shown in table 1[1].

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1) The realignments are calculated as the percentage change of a currency against the other EMS-currencies. For a detailed discussion of these realignments see J. van Ypersele, The European Monetary System: origins, operations and outlook, European Perspectives Series, Brussels, 1985, pp. 81-86 and European Economy, supplement A, September 1985 and April 1986.

Table 1. The realignments of the central rates within the EMS

EMS-currencies (abbreviations between brackets)	Deutsche mark (DM)	French franc (FF)	Dutch guilder (NG)	Italian lira (IL)	Belgian franc (BF)	Danish krone (DK)	Irish pound (IP)	Dummies
24 September 1979	+2.0	-	-	-	-	-2.9	-	D_R^{79A}
30 November 1979	-	-	-	-	-	-4.8	-	D_R^{79B}
23 March 1981	-	-	-	-6.0	-	-	-	D_R^{81A}
5 October 1981	+5.5	-3.0	+5.5	-3.0	-	-	-	D_R^{81B}
22 February 1982	-	-	-	-	-8.5	-3.0	-	D_R^{82A}
14 June 1982	+4.25	-5.75	+4.25	-2.75	-	-	-	D_R^{82B}
23 March 1983	+5.5	-2.5	+3.5	-2.5	+1.5	+2.5	-3.5	D_R^{83}
22 July 1985	+2.0	+2.0	+2.0	-6.0	+2.0	+2.0	+2.0	-
6 April 1986	+3.0	-3.0	+3.0	-	+1.0	+1.0	-	-

Even in the beginning of the EMS realignments appeared to be necessary, although they affected just one or two currencies. However, in 1981 a drastic realignment was triggered off for more currencies because of the sharp fall of the French franc after the presidential elections of May 1983. Also in 1982 and 1983 extensive realignments were carried through with a maximum bilateral devaluation of 10%.

We consider once more the movements of the various relative positions over the first six years, which are shown in figure 1 (see section 1.1.). In contemplating these fluctuations, the effects of the realignments on the relative positions should be taken into account. A realignment implies a 'break' in the development of the relative positions within the EMS-band, since (some) central rates have been changed and the relative positions have to be recalculated using these new central rates. Thus the development of a relative position cannot be represented by a smooth curve, but shows in principle seven interruptions during the sample period[1]. A weak and therefore devaluated currency will be found temporarily higher (at the top)

1) The graphs in figure 1 reflect the relative positions on the last Friday of each month, sometimes two or three weeks after a realignment. Nevertheless, most realignments are perceptible as 'jumps' in the graphs.

within the EMS-band and a strong and revaluated currency temporarily lower (at the bottom). The relative positions of the Deutsche mark (DM) and Dutch guilder (NG) for example show clearly a 'break' and a temporary weakness because of the realignments in June 1982 and March 1983. The guilder by and large followed the development of the mark and was together with the mark most of the time the strongest currency of the system. As a consequence of the strong appreciation of the U.S. dollar in 1984, the mark and guilder became less attractive and depreciated gradually during that year. On the other hand, the relative position of the Belgian franc (BF) stayed always in the lower half of the band and frequently at the bottom. The Belgian franc was often the weakest currency of the system.

We will from now on analyze the influence of the various determinants on the relative positions in the short term, i.e. on a monthly base. For that purpose absolute changes of the relative positions (ΔEMS) are regressed on absolute or percentage changes of the explanatory variables using monthly data. To eliminate the distortion resulting from the realignments, the regressions will include dummies for all realignments according to an additive dummy-method[1].

2.1. The nominal and real money market interest rates

The most important determinant of monthly changes of the relative position of a currency is the difference between the domestic and foreign short-term interest rates, which causes (voluminous) short capital flows with abroad. Hence the effect of absolute changes of differences in the nominal interest rate will be examined by means of regression analysis. In this case we have chosen the difference between the domestic money market interest rate (i_ℓ) and a weighted average of the money market interest rate in all EMS-countries (i_{ECU}). The weights roughly correspond with those in the ECU-basket (W_X)[2]. Table 2.A. comprises the outcomes of the regressions for the seven relative positions within the EMS, using Zellner's SUR-method as

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1) See S.C.W. Eijffinger, Over de beheersbaarheid van de geldhoeveelheid - Een macro-economische analyse voor Nederland, Amsterdam, 1986, pp. 200-203.

2) The pound sterling is not included in the weighted average interest rate, because the United Kingdom does not participate in the EMS-exchange rate mechanism. For this reason the weights of the other currencies within the ECU are slightly raised. See Appendix for an account of the weights.

Table 2.A.

$\Delta EMS_t = a_1 + a_2\Delta(i_t - i_{ECU}) + d_1D_R^{79A} + d_2D_R^{79B} + d_3D_R^{81A} + d_4D_R^{81B} + d_5D_R^{82A} + d_6D_R^{82B} + d_7D_R^{83}$ SUR-method

(79:6-84:12)	a_1	a_2	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM	0.114* (3.66)	0.191* (2.92)	-1.551* (6.43)	0.025 (0.10)	-0.032 (0.13)	-2.091* (8.66)	-0.680* (2.80)	-2.387* (9.84)	-2.304* (9.53)	2.23	0.54	0.47	0.507
FF	-0.057* (2.92)	-0.106* (3.94)	-0.126 (0.84)	0.128 (0.85)	-0.106 (0.69)	1.787* (11.86)	-0.662* (4.39)	1.726* (11.45)	0.107 (0.71)	2.50	0.44	0.36	0.399
NG	0.091* (5.28)	0.093* (4.06)	-0.487* (3.62)	-0.132 (0.97)	-0.059 (0.43)	-1.172* (8.75)	-0.655* (4.90)	-2.184* (16.28)	-2.301* (17.16)	1.50	0.58	0.52	0.378
IL	-0.116 (1.99)	-0.124 (1.48)	-2.542* (5.55)	-2.167* (4.79)	3.470* (7.68)	1.190* (2.60)	-0.566 (1.25)	3.395* (7.47)	2.784* (6.16)	2.23	0.60	0.55	0.696
BF	-0.040* (3.28)	-0.008 (0.63)	-0.199* (2.10)	-0.752* (7.93)	-0.017 (0.18)	1.109* (11.68)	0.902* (9.51)	1.168* (12.22)	0.839* (8.85)	2.15	0.43	0.36	0.319
DK	-0.087* (2.84)	0.014 (1.55)	2.256* (9.29)	1.216* (5.03)	-0.072 (0.30)	0.937* (3.94)	0.560* (2.35)	0.570* (2.37)	0.928* (3.90)	2.13	0.37	0.28	0.503
IP	-0.058* (3.18)	-0.089* (4.13)	-0.499* (3.49)	-0.279 (1.97)	-0.159 (1.07)	0.582* (4.10)	0.047 (0.33)	1.549* (10.92)	1.924* (13.49)	2.53	0.42	0.34	0.389

Table 2.B.

$\Delta EMS_t = a_1 + a_2\Delta(i_t - i_{ECU})_{-1} + d_1D_R^{79A} + d_2D_R^{79B} + d_3D_R^{81A} + d_4D_R^{81B} + d_5D_R^{82A} + d_6D_R^{82B} + d_7D_R^{83}$ SUR-method

(79:7-84:12)	a_1	a_2	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM	0.107* (3.30)	-0.004 (0.06)	-1.557* (6.21)	0.114 (0.45)	0.171 (0.67)	-2.119* (8.37)	-0.602* (2.40)	-2.318* (9.24)	-2.346* (9.34)	2.32	0.53	0.46	0.517
FF	-0.069* (3.67)	0.143* (5.67)	-0.213 (1.45)	0.175 (1.20)	0.070 (0.48)	1.799* (12.39)	-0.642* (4.42)	1.823* (12.51)	0.061 (0.42)	2.37	0.46	0.38	0.394
NG	0.103* (6.93)	0.130* (6.51)	-0.567* (4.88)	0.016 (0.14)	-0.124 (1.06)	-1.071* (9.15)	-0.625* (5.38)	-2.241* (19.19)	-2.356* (20.29)	1.69	0.63	0.58	0.352
IL	-0.102 (1.80)	-0.073 (0.90)	-2.461* (5.61)	-2.095* (4.75)	3.411* (7.74)	1.072* (2.44)	-0.595 (1.36)	3.468* (7.90)	2.796* (6.37)	2.19	0.62	0.56	0.685
BF	-0.046* (4.05)	0.105* (8.62)	-0.176* (2.01)	-0.773* (8.84)	-0.078 (0.89)	1.129* (12.91)	0.973* (11.09)	1.171* (13.39)	0.825* (9.44)	2.19	0.49	0.41	0.305
DK	-0.066* (2.35)	-0.012 (1.52)	2.269* (10.36)	1.131* (5.21)	-0.093 (0.43)	0.949* (4.31)	0.532* (2.44)	0.510* (2.35)	0.912* (4.20)	2.21	0.39	0.31	0.483
IP	-0.060* (3.11)	-0.019 (0.88)	-0.421* (2.84)	-0.265 (1.77)	0.015 (0.10)	0.585* (3.90)	-0.028 (0.19)	1.528* (10.31)	1.833* (12.08)	2.50	0.41	0.32	0.398

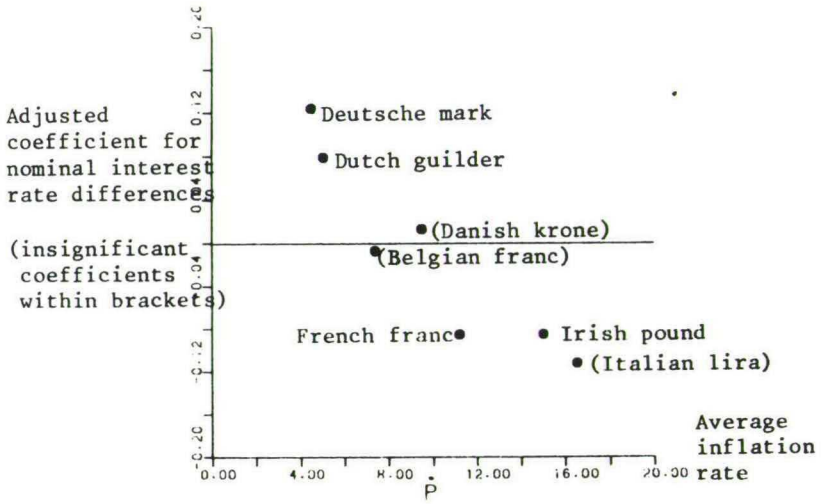
t-values within brackets
* = significant at a 5%-confidence level
DW= Durbin-Watson statistic (first-order autocorrelation)
R^2= squared multiple correlation coefficient
$\bar{R}^2$= idem, adjusted for degrees of freedom
SE= standard deviation of regression

estimation technique[1]. In interpreting the size of the coefficients for interest rate differences, the various weights within the average EMS-interest rate should also be considered. The Dutch interest rate for example has less than half the weight of the German interest rate. Therefore, the coefficients of the interest rate differences have to be corrected with regard to the weights. The relative positions do not seem to be very sensitive for nominal interest rate differences, since none of the coefficients is really high. The relation between these differences and the relative positions appears to be positive for the Deutsche mark and Dutch guilder and negative for the French franc, Italian lira and Irish pound. For the Belgian franc and Danish krone though, an insignificant and very poor relation is found. Figure 3 relates the coefficients of the nominal interest rate differences, adjusted for the weights, to the average inflation rates of the seven countries within the sample period. Evidently, there exists an inverse correlation between the influence of nominal interest rates on relative positions and the inflation rates within the EMS.
Thus a rise of the nominal interest rate leads in a country with low inflation to a higher relative position, but in a country with high inflation to a lower relative position.

Table 2.B. shows the results of the regressions, if the absolute changes of differences in the nominal interest rate are lagging behind one month. The lagged nominal interest rate differences give other outcomes than the unlagged differences (in table 2.A.). The relation between the lagged differences and the relative positions proved to be insignificant and (very) poor for the Deutsche mark, Italian lira, Danish krone and Irish pound. Nevertheless, for the French franc, Dutch guilder and Belgian franc a strongly significant and positive relation is found. Despite the remarkable significance in the case of these latter currencies, these lagged effects are in

1) The method of SUR (Seemingly Unrelated Regressions) takes into account the correlation between disturbances of the separate equations at the same time and so produces more efficient estimations - i.e. with a smaller variance - than the method of OLS (Ordinary Least Squares). Compare A. Zellner, An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias, Journal of the American Statistical Association, vol. 57, June 1962, pp. 348-368.

Figure 3. Correlation between the effect of nominal interest rate differences on relative positions and the inflation rates (April 1979 - December 1984)[1]



our opinion less important than the immediate effects of interest rate differences. Evidently, for a highly efficient market, like the exchange market, the direct influence - within one month -of short-term interest rates is far more interesting. Consequently, we will focus further only on unlagged interest rate differences as explanatory variables.

Table 3.A. comprises the results of the regressions, if the weighted average money market interest rate within the EMS is replaced by the U.S. money market interest rate (three-month eurodollarrate, i_{VS}) for the Deutsche mark and by the German money market interest rate (i_{DM}) for the other currencies[2]. The reason for this asymmetrical variant of the nominal interest rate differences is the dominating role of West-Germany within the EMS. Moreover, the Deutsche mark is more or less followed by the other EMS-currencies vis-à-vis the U.S. dollar and the EMS could thereby be characterized as a 'Deutsche mark-block'. This would also be reflected in the money market interest rates in West-Germany and the other EMS-countries.

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1) The coefficient for the nominal interest rate difference (a_2 in table 2.A.) is adjusted for the weight (W_ℓ) in the average EMS-interest rate: $a_2 (1 - W_\ell)$.

2) These and next following regressions have been estimated with the OLS-method in stead of the SUR-method on practical grounds.

Table 3.A.

$$\Delta EMS_t = a_1 + \begin{bmatrix} a_2\Delta(i_t - i_{DM}) \\ a_2\Delta(i_{DM} - i_{VS}) \end{bmatrix} + d_1D_R^{79A} + d_2D_R^{79B} + d_3D_R^{81A} + d_4D_R^{81B} + d_5D_R^{82A} + d_6D_R^{82B} + d_7D_R^{83}$$ OLS-method

(79:6-84:12)	a_1	a_2	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM	0.105 (1.62)	0.069 (1.64)	-1.533* (3.03)	0.082 (0.16)	-0.157 (0.29)	-2.273* (4.36)	-0.489 (0.96)	-2.238* (4.40)	-2.311* (4.56)	2.26	0.55	0.49	0.502
FF	-0.053 (1.02)	-0.086 (1.50)	-0.117 (0.29)	0.088 (0.22)	-0.173 (0.41)	1.801* (4.45)	-0.695 (1.71)	1.698* (4.18)	0.122 (0.30)	2.52	0.43	0.35	0.401
NG	0.086 (1.77)	0.059 (0.81)	-0.506 (1.32)	-0.065 (0.17)	-0.026 (0.07)	-1.171* (3.08)	-0.625 (1.64)	-2.148* (5.65)	-2.327* (6.12)	1.48	0.58	0.52	0.377
IL	-0.120 (1.33)	-0.022 (0.18)	-2.448* (3.47)	-2.138* (3.03)	3.443* (4.86)	1.100 (1.55)	-0.573 (0.82)	3.449* (4.87)	2.803* (4.02)	2.23	0.61	0.56	0.691
BF	-0.040 (0.97)	0.003 (0.07)	-0.201 (0.63)	-0.748* (2.32)	-0.011 (0.03)	1.103* (3.43)	0.907* (2.81)	1.158* (3.59)	0.839* (2.62)	2.16	0.44	0.36	0.318
DK	-0.088 (1.35)	0.017 (0.86)	2.239* (4.31)	1.239* (2.39)	-0.060 (0.12)	0.940 (1.85)	0.575 (1.12)	0.586 (1.14)	0.919 (1.81)	2.12	0.37	0.28	0.503
IP	-0.055 (1.08)	-0.073 (1.37)	-0.484 (1.23)	-0.309 (0.78)	-0.204 (0.68)	0.588 (1.50)	0.002 (0.00)	1.517* (3.88)	1.928* (4.89)	2.52	0.43	0.35	0.388

Table 3.B.

$$\Delta EMS_t = a_1 + a_2\Delta(r_t - r_{ECU}) + d_1D_R^{79A} + d_2D_R^{79B} + d_3D_R^{81A} + d_4D_R^{81B} + d_5D_R^{82A} + d_6D_R^{82B} + d_7D_R^{83}$$ OLS-method

(79:8-84:12)	a_1	a_2	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM	0.114 (1.68)	0.111 (1.07)	-1.664* (3.14)	0.017 (0.03)	0.126 (0.24)	-2.177* (4.16)	-0.662 (1.27)	-2.277* (4.36)	-2.353* (4.52)	2.25	0.54	0.47	0.516
FF	-0.051 (0.96)	-0.083 (1.40)	-0.125 (0.30)	0.164 (0.40)	-0.057 (0.14)	1.792* (4.38)	-0.641 (1.57)	1.763* (4.30)	-0.038 (0.09)	2.54	0.43	0.35	0.406
NG	0.110* (2.28)	0.077 (1.11)	-0.548 (1.49)	-0.084 (0.23)	-0.108 (0.29)	-1.176* (3.19)	-0.627 (1.70)	-2.222* (5.97)	-2.360* (6.41)	1.57	0.61	0.56	0.365
IL	-0.103 (1.15)	-0.073 (1.22)	-2.705* (3.77)	-2.232* (3.25)	3.574* (5.19)	1.050 (1.54)	-0.679 (0.99)	3.448* (5.05)	2.823* (4.13)	2.39	0.63	0.58	0.677
BF	-0.040 (0.97)	0.054 (1.59)	-0.184 (0.58)	-0.698* (2.20)	-0.041 (0.13)	1.145* (3.61)	0.909* (2.87)	1.101* (3.45)	0.784* (2.46)	2.32	0.47	0.39	0.314
DK	-0.068 (1.05)	0.018 (0.92)	2.238* (4.47)	1.193* (2.39)	-0.069 (0.14)	0.907 (1.84)	0.556 (1.12)	0.553 (1.11)	0.876 (1.76)	2.23	0.39	0.30	0.490
IP	-0.052 (1.00)	-0.048 (1.29)	-0.492 (1.22)	-0.298 (0.74)	-0.081 (0.20)	0.540 (1.35)	0.098 (0.24)	1.563* (3.91)	1.819* (4.55)	2.58	0.42	0.34	0.395

$$r = i - \dot{p}^e = i - \left[\frac{p - p(-6)}{p(-6)} \times 200\right]$$

t-values within brackets
* = significant at a 5%-confidence level
DW= Durbin-Watson statistic (first-order autocorrelation)
R^2= squared multiple correlation coefficient
$\bar{R}^2$= idem, adjusted for degrees of freedom
SE= standard deviation of regression

The relation between these interest rate differences and the relative positions appeared to be insignificant and poor for all currencies. The asymmetrical variant is apparently less succesful than the symmetrical one (in table 2.A.) and will further be left aside.

Table 3.B. shows the outcomes of the regressions, if the nominal interest rate differences are substituted by the real interest rate differences ($r_\ell - r_{ECU}$), i.e. the nominal interest rate differences minus the inflation rate differences. The connection between the effect of the nominal interest rate and the inflation rate (see figure 3) points at the need to distinguish nominal and real interest rates. A rise of the nominal interest rate could be caused by an increased expected inflation. This would lead to a lower relative position and could explain a negative relation between nominal interest rates and relative positions. Therefore, we have to examine the influence of real interest rate differences[1]. The relation between these real differences and the relative positions is found to be insignificant and positive for strong currencies in countries with low inflation (Deutsche mark and Dutch guilder), but negative for weak currencies in countries with high inflation (French franc, Italian lira and Irish pound). Thus the conclusion is the same as for the nominal interest rate differences.

2.2. The interventions in the exchange market

As a consequence of the bilateral intervention limits (and divergence thresholds) within the EMS, the exchange market interventions or changes in the official reserves of the central banks are predominant determinants of absolute changes of the relative positions concerned. Henceforth, we will examine the effects of exchange market interventions with regression analysis. The equations including the unlagged nominal interest rate differences (see table 2.A.) are taken as point of departure. To these equations the exchange markets interventions (ΔNFA^{cb}) of the central banks are added as an extra explanatory variable for the relative positions, which correspond with the intervening central bank. In some cases (French franc, Danish krone and Irish pound) no monthly data of the interventions were available

1) As a proxy for the expected inflation rate the actual inflation rate during the last six months on an annual base is chosen. So the adaptive expectations hypothesis is assumed.

and quarterly data had to be interpolated to monthly data[1].

Table 4.A. gives the results of the regressions for nominal interest rate differences with the exchange market interventions as an additional variable[2]. The relation between the interventions and the relative positions proved to be positive for most currencies, while a negative sign would be expected. The coefficient is positive and significant for the Dutch guilder and Italian lira and almost significant for the French franc and Danish krone. However, for the other currencies the coefficient appeared to be insignificant and poor, except for the Irish pound.

The outcome of a positive or poor relation in stead of a negative one could be explained by interventions of a central bank with regard to other than its own currency. This seems no plausible hypothesis for most countries with an exception for West-Germany. A considerable part of the interventions by the Deutsche Bundesbank is directed on the Deutsche mark-dollar exchange rate and has no connection with the relative position of the Deutsche mark.

It is more likely that the positive and (almost) significant coefficient can be attributed to 'reversed causality', i.e. a causal relation from the relative position of a currency to the interventions by its central bank. A rise of the relative position forces the central bank concerned to sell its own currency, in particular if the upper intervention limit is reached. Consequently, a positive relation points to the reaction function for the exchange market policy of a central bank.

2.3. The accounts of the balance of payments

As commonly known, disequilibria on the current and capital account of the balance of payments are reflected in the demand for and supply of foreign currencies in a country and therefore influence the relative position of its currency. A surplus on the current or capital account implies an import of foreign currencies and will increase the relative position. The current account has a more or less equable development in the short term and will determine the relative position mainly in the longer run. Though we will examine the effects of the current account, using regression analysis. On

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1) By calculating the moving average of these quarterly data. This leads to a smoothing of the data, which may affect the significance of the interpolated variable.

2) For the Italian lira and Irish pound a shorter sample period is chosen to correct for differences in revaluating the official reserves of the central banks concerned.

Table 4.A.

$\Delta EMS_t = a_1 + a_2\Delta(i_t - i_{ECU}) + a_3\Delta NFA^{cb} + d_1D_R^{79A} + d_2D_R^{79B} + d_3D_R^{81A} + d_4D_R^{81B} + d_5D_R^{82A} + d_6D_R^{82B} + d_7D_R^{83}$ OLS-method

	a_1	a_2	a_3	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM (79:6-84:12)	0.119 (1.73)	0.226 (1.22)	0.007 (0.28)	-1.622* (2.82)	0.065 (0.12)	-0.129 (0.21)	-2.047* (3.78)	-0.701 (1.34)	-2.406* (4.61)	-2.339* (4.39)	2.24	0.54	0.47	0.511
FF (79:6-84:11)	-0.066 (1.26)	-0.115 (1.48)	0.025 (1.67)	-0.125 (0.31)	0.115 (0.29)	-0.114 (0.28)	1.841* (4.62)	-0.562 (1.40)	1.979* (4.62)	0.131 (0.33)	2.63	0.47	0.38	0.393
NG (79:6-84:12)	0.074 (1.55)	0.100 (1.23)	0.147* (2.38)	-0.403 (1.08)	-0.066 (0.18)	-0.035 (0.09)	-1.020* (2.75)	-0.645 (1.76)	-2.186* (5.95)	-2.069* (5.42)	1.61	0.62	0.56	0.363
IL (81:1:84:1)	-0.146 (1.29)	-0.049 (0.23)	0.199* (2.66)	–	–	4.056* (5.92)	1.183 (1.74)	-0.364 (0.56)	2.979* (4.38)	2.892* (4.44)	2.92	0.75	0.67	0.639
BF (79:6-84:12)	-0.043 (1.05)	0.017 (0.30)	-0.003 (0.97)	-0.104 (0.31)	-0.715* (2.23)	-0.111 (0.33)	1.109* (3.45)	0.868* (2.68)	1.158* (3.56)	0.821* (2.56)	2.16	0.45	0.36	0.317
DK (79:6-84:12)	-0.076 (1.18)	0.025 (1.18)	0.107 (1.62)	2.294* (4.45)	1.237* (2.42)	-0.011 (0.02)	0.955 (1.90)	0.713 (1.40)	0.611 (1.21)	0.805 (1.59)	2.22	0.40	0.30	0.496
IP (81:2-84:12)	-0.077 (1.13)	-0.083 (0.98)	-0.514 (0.45)	–	–	-0.105 (0.22)	0.561 (1.27)	0.071 (0.16)	1.557* (3.57)	1.977* (4.40)	2.66	0.47	0.34	0.431

Table 4.B.

$\Delta EMS_t = a_1 + a_2\Delta(i_t - i_{ECU}) + a_3CU + d_1D_R^{79A} + d_2D_R^{79B} + d_3D_R^{81A} + d_4D_R^{81B} + d_5D_R^{82A} + d_6D_R^{82B} + d_7D_R^{83}$ OLS-method

	a_1	a_2	a_3	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM (79:6-84:12)	0.128 (1.95)	0.181 (1.10)	0.038 (1.66)	-1.471* (2.91)	0.039 (0.08)	0.072 (0.13)	-2.235* (4.37)	-0.688 (1.35)	-2.427* (4.78)	-2.444* (4.77)	2.17	0.56	0.49	0.500
FF (79:6-84:11)	-0.045 (0.67)	-0.139 (1.77)	0.002 (0.09)	-0.147 (0.36)	0.118 (0.29)	-0.151 (0.36)	1.776* (4.36)	-0.669 (1.64)	1.720* (4.13)	0.113 (0.27)	2.52	0.44	0.35	0.403
NG (79:6-84:12)	0.108* (2.01)	0.062 (0.74)	-0.053 (0.85)	-0.560 (1.44)	-0.129 (0.33)	-0.080 (0.21)	-1.156* (3.02)	-0.595 (1.54)	-2.137* (5.55)	-2.263* (5.84)	1.51	0.59	0.52	0.378
IL (79:6-84:12)	-0.111 (1.12)	0.017 (0.11)	0.026 (0.27)	-2.418* (3.37)	-2.105* (2.98)	3.502* (4.90)	1.104 (1.52)	-0.522 (0.73)	3.488* (4.91)	3.820* (3.99)	2.24	0.61	0.55	0.697
BF (79:6-84:2)	-0.076 (0.97)	0.037 (0.67)	-2.202 (0.32)	0.193 (0.57)	-0.736* (2.17)	0.001 (0.00)	1.097* (3.24)	0.894* (2.49)	1.146* (3.35)	0.862* (2.55)	2.21	0.47	0.37	0.334
DK (79:6-84:12)	0.179 (0.97)	0.025 (1.17)	0.220 (1.53)	2.249* (4.36)	1.350* (2.61)	-0.138 (0.27)	0.976 (1.94)	0.725 (1.41)	0.654 (1.28)	0.836 (1.66)	2.19	0.40	0.30	0.497
IP (81:2-84:12)	-0.004 (0.03)	-0.078 (0.912)	0.754 (0.63)	–	–	-0.071 (0.15)	0.603 (1.38)	0.158 (0.34)	1.563* (3.59)	1.976* (4.46)	2.63	0.47	0.35	0.430

t-values within brackets
* = significant at a 5%-confidence level
DW= Durbin-Watson statistic (first-order autocorrelation)
R^2= squared multiple correlation coefficient
$\bar{R}^2$= idem, adjusted for degrees of freedom
SE= standard deviation of regression

the capital account a distinction should be made between long and short capital flows. For the long capital account the same remark holds as for the current account. However, the short capital account will affect the relative position primarily in the short term. The short interest-induced capital flows are already represented in the equations by the nominal interest rate differences. Besides these flows the short non-interest-induced capital flows (e.g. short trade credit) can also influence the relative position. Since data of the short non-interest-induced capital flows were missing, the short capital account is totally included in the equations as a seperate variable. Furthermore, in most cases (except West-Germany) no monthly data were available and quarterly data had to be interpolated. For all accounts we expect a positive coefficient.
Table 4.B. comprises the outcomes of the regressions for nominal interest rate differences with the current account (CU) as an additional variable. The relation between the current accounts and the relative positions is found to be almost significant and positive for the Deutsche mark and Danish krone, but insignificant and very poor for the other currencies. These results could be caused by the interpolation from quarterly data for all countries but West-Germany and the lack of reliability in the balance of payments statistics in many countries.

Tables 5.A. and 5.B. show the outcomes of the regressions for nominal interest rate differences with the short capital account (CA^S) and the long capital account (CA^L) respectively as additional variables[1]. The relation between the short or long capital account and the relative positions appeared to be insignificant for all countries. Moreover, the coefficient has for one or two countries even a wrong, negative sign. This could also result from the interpolation and unreliability of the data.
Nevertheless, we may conclude that the current and capital account of the balance of payments in general have no significant influence on the relative position of a currency in the short run. In the longer term these accounts will certainly affect the market rate and the relative position, and therefore cause a realignment of the central rate and a change of the central position.

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1) For Ireland only annual data of the short and long capital account were available and thus no regressions could be carried out for the Irish pound.

Table 5.A.

$\Delta EMS_t = a_1 + a_2\Delta(i_t - i_{ECU}) + a_3 CA^S + d_1 D_R^{79A} + d_2 D_R^{79B} + d_3 D_R^{81A} + d_4 D_R^{81B} + d_5 D_R^{82A} + d_6 D_R^{82B} + d_7 D_R^{83}$ OLS-method

	a_1	a_2	a_3	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM (79:6-84:12)	0.111 (1.67)	0.168 (0.99)	-0.019 (1.00)	-1.361* (2.50)	-0.087 (0.17)	0.181 (0.31)	-2.243* (4.21)	-0.658 (1.27)	-2.302* (4.40)	-2.254* (4.38)	2.19	0.55	0.48	0.507
FF (79:6-84:11)	-0.057 (0.97)	-0.133 (1.66)	0.003 (0.31)	-0.139 (0.34)	0.118 (0.29)	-0.146 (0.35)	1.746* (4.19)	-0.675 (1.66)	1.705* (4.19)	0.098 (0.24)	2.53	0.44	0.35	0.403
NG (79:6-84:12)	0.079 (1.58)	0.078 (0.92)	0.060 (1.04)	-0.536 (1.40)	-0.167 (0.42)	-0.032 (0.08)	-1.186* (3.11)	-0.666 (1.75)	-2.155* (5.64)	-2.282* (5.96)	1.51	0.59	0.52	0.377
IL (79:6-84:12)	-0.142 (1.49)	0.024 (0.15)	0.111 (0.58)	-2.322* (3.15)	-2.032* (2.82)	3.509* (4.94)	1.066 (1.48)	-0.461 (0.63)	3.501* (4.91)	2.752* (3.86)	2.25	0.61	0.55	0.701
BF (79:6-84:2)	-0.046 (0.95)	0.027 (0.49)	-3.830 (0.84)	-0.187 (0.56)	-0.723* (2.16)	-0.063 (0.18)	1.132* (3.35)	0.982* (2.88)	1.144* (3.37)	0.917* (2.68)	2.19	0.48	0.38	0.332
DK (79:6-84:12)	-0.096 (1.41)	0.022 (1.01)	0.058 (0.48)	2.229* (4.25)	1.188* (2.21)	-0.106 (0.21)	0.964 (1.88)	0.567 (1.10)	0.616 (1.19)	0.910 (1.78)	2.12	0.37	0.28	0.506
IP —	–	–	–	–	–	–	–	–	–	–	–	–	–	–

Table 5.B.

$\Delta EMS_t = a_1 + a_2\Delta(i_t - i_{ECU}) + a_3 CA^L + d_1 D_R^{79A} + d_2 D_R^{79B} + d_3 D_R^{81A} + d_4 D_R^{81B} + d_5 D_R^{82A} + d_6 D_R^{82B} + d_7 D_R^{83}$ OLS-method

	a_1	a_2	a_3	d_1	d_2	d_3	d_4	d_5	d_6	d_7	DW	R^2	$\bar{R}^2$	S.E.
DM (79:6-84:12)	0.111 (1.67)	0.194 (1.16)	-0.018 (0.60)	-1.497* (2.87)	-0.026 (0.05)	-0.004 (0.01)	-2.127* (4.11)	-0.693 (1.33)	-2.429* (4.66)	-2.369* (4.49)	2.19	0.54	0.47	0.510
FF (79:6-84:11)	-0.054 (1.02)	-0.131 (1.67)	0.008 (0.69)	-0.126 (0.31)	0.154 (0.38)	-0.115 (0.28)	1.816* (4.44)	-0.665 (1.64)	1.732* (4.26)	0.071 (0.17)	2.53	0.44	0.36	0.401
NG (79:6-84:12)	0.119 (1.87)	0.050 (0.60)	0.066 (0.74)	-0.523 (1.36)	-0.051 (0.13)	-0.091 (0.23)	-1.162* (3.04)	-0.598 (1.54)	-2.145* (5.57)	-2.276* (5.88)	1.52	0.58	0.52	0.379
IL (79:6-84:11)	-0.101 (0.79)	0.024 (0.15)	-0.083 (0.30)	-2.433* (3.36)	-2.115* (2.97)	3.501* (4.89)	1.108 (1.51)	-0.537 (0.75)	3.515* (4.87)	2.793* (3.93)	2.23	0.61	0.55	0.702
BF (79:6-84:2)	-0.056 (1.17)	0.037 (0.69)	0.034 (0.01)	-0.189 (0.56)	0.727* (2.15)	0.007 (0.02)	1.104* (3.25)	0.934* (2.76)	1.139* (3.30)	0.861* (2.54)	2.20	0.47	0.37	0.335
DK (79:6-84:12)	-0.222 (1.82)	0.020 (0.97)	0.100 (1.30)	2.306* (4.42)	1.283* (2.49)	-0.011 (0.02)	0.982 (1.94)	0.616 (1.21)	0.540 (1.05)	0.832 (1.63)	2.17	0.39	0.29	0.500
IP —	–	–	–	–	–	–	–	–	–	–	–	–	–	–

t-values within brackets
* =significant at a 5%-confidence level
DW=Durbin-Watson statistic (first-order autocorrelation)
R^2=squared multiple correlation coefficient
$\bar{R}^2$=idem, adjusted for degrees of freedom
SE=standard deviation of regression

3. Conclusion

In the previous sections the exchange rate mechanism of the EMS and in particular the relative positions of the currencies within the EMS-band of fluctuation have been analysed both theoretically and empirically. The relative positions reflect the development of bilateral market rates within the parity grid in a multilateral and comparative way.

The modelling of bilateral exchange rates in the short term has been without much success up to this day, because the short-run fluctuations of exchange rates are large and volatile. Therefore, the coefficients in these exchange rate models proved to be mostly instable and so not suited for making out-of-sample forecasts[1]. Despite the bilateral fluctuation margins within the EMS, this volatility of exchange rate movements is also strongly expressed in the monthly fluctuations of the relative positions of the EMS-currencies.

Consequently, the modelling of relative positions in the short term appeared to be complicated as well. The 'fundamentals', such as the long capital account, the current account, the inflation rate and the growth rate of the money stock[2], determine the relative position of a currency mainly in the longer run and are thus represented by the realignments of central rates and the changes of central positions. Nevertheless, these fundamentals do not affect the short-term development of the relative positions within the EMS-band.

The short-run determinants of the relative positions appeared to be primarily the nominal interest rate differences and the exchange rate expectations. The most striking result of this study is the negative relation between the nominal interest rate and relative position for the weak EMS-currencies of countries with a high inflation rate. This could be explained by the exchange rate expectations of the agents on the foreign exchange markets (banks, investors and speculators), for which the financial

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1) In an empirical study of Meese & Rogoff is found that such exchange rate models cannot forecast more precise than a so-called 'random-walk model', i.e. a model in which the exchange rate is explained by random errors. See R. Meese & K. Rogoff, The out-of-sample failure of empirical exchange rate models: Sampling error or misspecification, J.A. Frankel (ed.), Exchange rates and international macroeconomics, Chicago, 1983.

2) Experiments with various differences of the inflation rate and the money growth rate (over three, six and twelve months on an annual base) between the EMS-countries resulted in poor and insignificant coefficients for these explanatory variables.

importance of the expected exchange rate movements often overshadows that of the interest rate differences[1].

When the weak currencies are expected to depreciate, then the relative positions of these currencies will eventually fall as a kind of 'self-fulfilling prophecy'. Therefore, the exchange rate expectations will determine the relative positions in the short term for a substantial part. They are however very difficult to model as explanatory variables[2]. Because of the exchange rate expectations the relation between the nominal interest rates and the relative positions is not so clear, as mostly is assumed to be. This should be taken into account in evaluating the exchange market policy and domestic monetary policy of the various countries within the EMS. Ultimately, only convergence in monetary and economic policy between the EMS-countries will lead to a mitigation of the exchange rate expectations and to a stabilization of the relative positions within the EMS-band of fluctuation.

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1) An expected depreciation of e.g. 2% during one month can only be offset by a nominal interest rate difference of 24% or more on an annual base.
2) Experiments with various proxies for the exchange rate expectations, like changes of inflation rate differences or changes of the current account have been tried, but proved to be unsuccessful.

Appendix: Notation of variables and source of data

EMS = relative positions of EMS-currencies (last Friday of the month) with DM = Deutsche mark, FF = French franc, NG = Dutch guilder, IL = Italian lira, BF = Belgian-Luxembourg franc, DK = Danish krone and IP = Irish pound (source: De Nederlandsche Bank);

i = money market interest rate
with i_{DM} = three-month cash loan rate (source: MEI),
i_{FF} = call money rate (source: MEI),
i_{NG} = three-month Treasury bills rate (source: CB),
i_{IL} = six-month Treasury bills rate (source: CB),
i_{BF} = three-month Treasury bills rate (source: MEI),
i_{DK} = call money rate (source: IFS),
i_{IP} = three-month Treasury bills rate (source: MEI),
and i_{VS} = three-month eurodollar rate (source: IFS);

$i_{ECU} = 0{,}35i_{DM} + 0{,}21i_{FF} + 0{,}15i_{NG} + 0{,}1i_{IL} + 0{,}1i_{BF} + 0{,}05i_{DK} + 0{,}05i_{IP}$;

p = consumption price index (* for Ireland), (source: MEI);

$p_{ECU} = 0{,}35p_{DM} + 0{,}2p_{FF} + 0{,}15p_{NG} + 0{,}1p_{IL} + 0{,}1p_{BF} + 0{,}05p_{DK} + 0{,}05p_{IP}$;

NFA^{cb} = official reserves of central bank (adjusted for revaluating), (billions for Italy and milliards for other countries), (Source: DM-CB, FF-BPS*, NG-CB, IL-CB, BF-CB, DK-CB* and IP-CB*);

CU = surplus or deficit on current account (billions for Belgium and Italy and milliards for other countries), (Source: DM-CB, FF-BPS*, NG-CB*, IL-CB, BF-BPS*, DK-CB* and IP-CB*);

CA^S = surplus or deficit on short capital account (billions for Belgium and Italy and milliards for other countries), (Source: DM-CB, FF-BPS*, NG-BPS*, IL-BPS*, BF-BPS*, DK-BPS* and IP-not available);

CA^L = surplus or deficit on long capital account (billions for Belgium and Italy and milliards for other countries), (Source: DM-CB, FF-BPS*, NG-BPS*, IL-BPS*, BF-BPS*, DK-BPS* and IP-not available);

Sources: MEI = Main Economic Indicators (OECD);
BPS = Balance of Payments Statistics (IMF);
IFS = International Financial Statistics (IMF);
CB = various monthly and quarterly statistics of the central banks concerned;
* = interpolation of quarterly data to monthly data.

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